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Publication date:
2011

Document Version
Accepted author manuscript, peer reviewed version

[Link to publication from Aalborg University](#)

Citation for published version (APA):

Zheng, Q., Youngman, R. E., Hogue, C. L., Mauro, J. C., Potuzak, M., Ellison, A. J., Smedskjær, M. M., & Yue, Y. (2011). *Structure and Topology of Na₂O-B₂O₃-Al₂O₃-SiO₂ Mixed Network Glasses*. Abstract from 2011 GOMD Annual Meeting of the American Ceramic Society, Savannah, United States.

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Structure and Topology of Na₂O-B₂O₃-Al₂O₃-SiO₂ Mixed Network Glasses

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Boroaluminosilicate glasses serve as the basis for a variety of industrial glasses. Hence, it is critical to understand the relationship between physical properties and structure of these mixed network former glasses. Also it is important to model the effects of composition on properties based on structural speciation by applying constraint theory and then to compare the modeled and experimental results. We have designed six Na₂O-B₂O₃-Al₂O₃-SiO₂ glasses with variation of the [Al₂O₃]/[SiO₂] ratio to access different regimes of sodium behavior. We use ¹¹B, ²⁷Al, ²⁹Si, and ²³Na MAS NMR to determine changes in both network speciation and modifier cation environment as a function of the composition. We link these structural changes to changes in measured thermal, mechanical, and rheological properties.